CLAIMS

1 Tissue substance measuring apparatus comprising:

an optical source comprising at least one semiconductor laser, the optical source being coupled to a tissue test site via an optical path which permits transmission of optical energy characterized as middle infrared from said optical source into said tissue; and a pressure transducer system acoustically coupled to said tissue test site.

2 Tissue substance measuring apparatus of claim 1, wherein said pressure transducer is arranged to receive acoustic energy generated as a result of absorption of the optical energy at the substance, or a component or marker of the substance, being measured.

3 Tissue substance measuring apparatus of claim 2, said at least one semiconductor laser includes a laser of the type known as a quantum cascade laser comprised of quantum well structures.

4 Tissue substance measuring apparatus of claim 3, said optical source comprises at least two discrete lasers, said lasers being arranged to address or couple with a common region of tissue.

5 Tissue substance measuring apparatus of claim 4, said at least two discrete lasers each operate on a different wavelength.

6 Tissue substance measuring apparatus of claim 5, the at least two discrete lasers are coupled via an optical multiplexer to form a beam which addresses the same tissue space, the lasers being operable independently in time.

7 Tissue substance measuring apparatus of claim 6, the multiplexer is an optical beam multiplexing device known as a beam combiner.

8 Tissue substance measuring apparatus of claim 6, the multiplexer is an optical beam multiplexing device known as a grating or prism type beam combiner.

9 Tissue substance measuring apparatus of claim 6, at least two discrete lasers are arranged to address substantially the same space or at least space having similar characteristics.

10 Tissue substance measuring apparatus of claim 1, said pressure transducer is coupled to the tissue test site via a coupling whereby the pressure transducer makes intimate and direct contact with a tissue surface.

11 Tissue substance measuring apparatus of claim 10, said pressure transducer is coupled to said tissue test site via a coupling comprised of a fluid operable for transmitting an acoustic wave therethrough.

12 Tissue substance measuring apparatus of claim 1, said optical source is further comprised of a modulation system electronically connected to said at least one semiconductor laser, the modulation system provides electronic pulses directly through said quantum cascade laser structure to directly modulate output beams.

13 Tissue substance measuring apparatus of claim 12, said modulation system is further comprised of a timing system and switch operable for delivering pulses characterized as delta function pulses.

14 Tissue substance measuring apparatus of claim 13, said pulses are formed into sets of pulses, or a pulse stream, of finite length, said sets of pulses being characterized as having a duty cycle less than 1/4.

15 Tissue substance measuring apparatus of claim 13, said timing system and switch operable for delivering pulse trains which cooperate with a pressure transducer system having a spatial distribution.

16 Tissue substance measuring apparatus of claim 1, wherein the optical source generates optical energy in a plurality of wavelength bands each having a center wavelength, the center wavelengths being arranged to correspond to portions of a glucose absorption spectrum where the slope is substantially non-zero.

17 Tissue substance measuring apparatus of claim 16, wherein the optical source generates optical energy in at least two wavelength bands each having a center wavelength, the center wavelengths being arranged to correspond to portions of a glucose absorption spectrum on either side of a point where the slope has a transition from increasing slope to decreasing slope, or decreasing slope to increasing slope.

18 Apparatus of claim 17, said center wavelengths are arranged to lie symmetrically about the same inflection point.

19 Tissue substance measuring apparatus of claim 1, further comprising a data storage means coupled with said pressure transducer system whereby amplitude data may be recorded and stored by the apparatus.

20 Tissue substance measuring apparatus of claim 19, the apparatus further comprises a data transmission means arranged to pass stored data to an independent system for post processing and archiving.

21 Tissue substance measuring apparatus of claim 1, said optical source comprises at least two semiconductor lasers of the same wavelength.

22 Methods of *in-vivo* substance measurement, comprising the steps:

a) exciting a quantum cascade semiconductor laser to form an optical pulse set of middle infrared optical radiation;

b) causing said optical pulse to become incident upon human tissue being measured;

c) receiving an acoustic return signal which results from interaction between said optical pulse set and substances from which said tissue is comprised; and

d) determining from the received acoustic signal information about a substance being addressed.

23 Methods of claim 22, said 'exciting' step is a direct modulation step whereby current pulses are driven through said semiconductor laser to effect periodic lasing.

24 Methods of claim 23, said current pulses are characterized as delta function pulses at a rate of between 10 hz to 10 khz.

25 Methods of 23, said current pulses include pulses arranged in a set of finite number.

26 Methods of claim 25, the period of pulses is arranged cooperate with a spatial arrangement of a pressure transducer system in view of the speed of acoustic waves in tissues being measured.

27 Methods of claim of 22, the 'causing the optical pulse' step is further defined as illuminating interstitial fluid just below an epidermis layer in a living human.

28 Methods of claim 27, said 'causing pulse to propagate' step is further defined as providing optical energy of a sufficient quantity such that a substantial portion will penetrate into tissue to a depth between 20 – 100 microns below the tissue surface.